

SERDP Conservation CSSION-01-03

A Regional Simulation to Explore Impacts of Resource Use and Constraints Project Number 1259

<http://www.esd.ornl.gov/programs/SERDP/RSim/index.html>

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Overview

The goal of this project was to design computer simulation model, the Regional Simulator (RSim), which integrates land-use changes with ecological effects of changes in noise, water and air quality and species of special concern and their habitats. RSim projects land-use changes and its impacts for the five counties in Georgia surrounding and including Fort Benning and is applicable to other regions and a diversity of resource managers. Data layers that are widely available are being used in the model. Four scenarios have been implemented. (A) The urban growth submodel in RSim consists of spontaneous growth of new urban areas and patch growth (growth of preexisting urban patches). (B) The road-influenced urbanization submodel focuses growth on areas near existing and new roads by considering the proximity of major roads to newly urbanized areas. (C) The new digital multipurpose range complex (DMPRC) at Fort Benning is an example of the pressures that are now being placed on military land for more use. (D) Spatially explicit impacts of a hurricane impact from a storm moving northward from the Gulf of Mexico are based on a storm that impacts the South Carolina coastal system. Projections from the various scenarios suggest that urban growth will continue along the northern border of Fort Benning and may have impacts on noise, water, and air quality. Declines in habitat of gopher tortoise as a likely result of land-use changes because urban growth and other land-use changes are highly likely on lands that now provide gopher tortoise habitat. Habitat for red cockaded woodpecker are not likely to be affected by projected land-cover changes under scenarios A, B and C for two reasons: (1) only 3% of the original habitat remains and (2) most of those remaining sites are on federally protected land that is managed for red cockaded woodpecker.

During this year of the project, we worked to place the RSim effort within the context of the region, ongoing military issues, and current theory. We specifically considered RSim in relation to future plans for the five-county region, transboundary issues at military installations, and the ecological theories relating to environmental security, ecological risk, and land use planning. We also began development of a user friendly interface for RSim so that the transfer of the final product will go smoothly and provide a worthwhile technology. This task involved planning by our computer design team and discussions with personal at Fort Benning and The Nature Conservancy. We continue to publish aspects of the work as it is completed, for submitting the work to peer review is the established method to gain scientific credibility necessary to have confidence that the methods are appropriate for resource management

RSim integrates various stressors and receptors through the linkages depicted in Figure 1. Stressors can act directly on receptors (e.g., noise acting on gopher tortoise or ozone acting on pines), or stressors can act indirectly on receptors via their habitat (e.g., ozone acting on red-cockaded woodpecker by adversely affecting pines). Integration can occur at the level of exposure, for example, if there are multiple sources of nitrogen in streams or ozone in air or blast noise. Similarly, the road-based and non-road-based urbanization are integrated in RSim. Or integration can occur at the level of effects (e.g., changes in abundance resulting from multiple causes of habitat removal and fragmentation, or changes in abundance resulting from the multiple stressors of habitat change, noise, and air pollution). Additionally, Figure 2 in “Planning transboundary ecological risk assessments at military installations,” Section 10a of this report, depicts how RSim might integrate several stressors that effect pine density, age structure and patch size to estimate changes in the abundance and production of red-cockaded woodpecker.

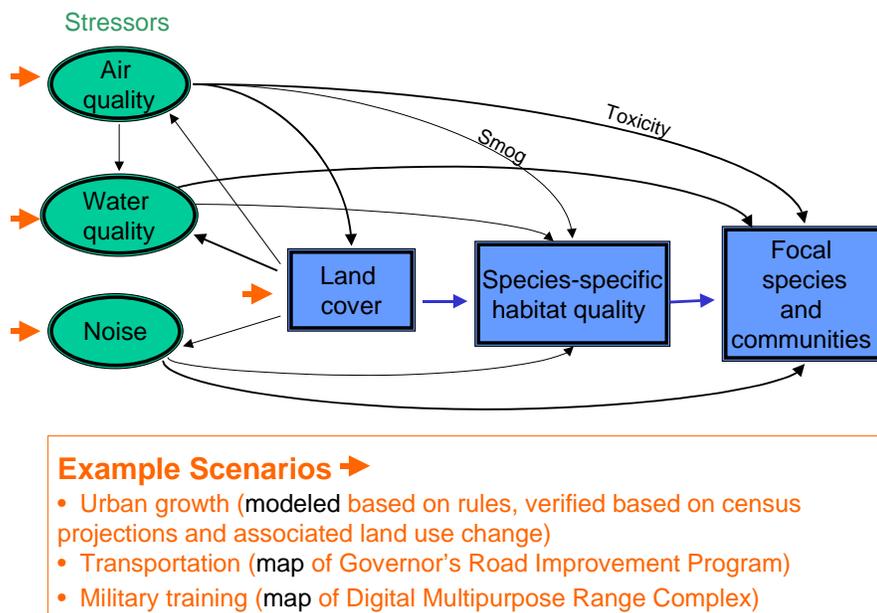


Figure 1. Integrated framework for RSim, showing example scenarios acting on stressors.

Relevant Publications

- Baskaran, L.M., V. H. Dale, and W. Birkhead. 2005. Habitat modeling within a Regional Simulation Model (RSim) environment. Pages 6-16 in the Proceedings of the 4th Southern Forestry and Natural Resource Management GIS Conference, Athens, GA, December 16-17, 2004.
- Baskaran, L.M., V.H. Dale, R. A. Efroymsen, and W. Birkhead. 2006. Habitat modeling within a regional context: An example using Gopher Tortoise. *American Midland Naturalist* 155: 335-351.
- Baskaran, L., V. Dale, C. Garten, D. Vogt, C. Rizy, R. Efroymsen, M. Aldridge, M. Berry, M. Browne, E. Lingerfelt, F. Akhtar, M. Chang and C. Stewart. 2006. Estimating land-cover change in RSim: Problems and constraints. *Proceedings for the American Society for Photogrammetry and Remote Sensing 2006 Conference*, Reno, NV, May 1-5 2006.
- Dale, V.H., S. Bartell, R. Brothers, and J. Sorenson. 2004. A systems approach to environmental security. *EcoHealth* 1:119-123.
- Dale, V.H, Duckenbrod, D., Baskaran, L., Aldridge, M., Berry, M., Garten, C., Olsen, L., Efroymsen, R., and Washington-Allen, R. 2005. Vehicle impacts on the environment at different spatial scales: Observations in west central Georgia. *Journal of Terramechanics* 42: 383-402.
- Dale, V., M. Aldridge, T. Arthur, L. Baskaran, M. Berry, M. Chang, R. Efroymsen, C. Garten, C. Stewart, and R. Washington-Allen. 2006. Bioregional Planning in Central Georgia. *Futures* 38:471-489.
- Dale, V.H., S. Archer, M. Chang, and D. Ojima. 2005. Ecological impacts and mitigation strategies for rural land management. *Ecological Applications* 15(6): 1879-1892.
- Efroymsen, R.A., V.A. Morrill, V.H. Dale, T.F. Jenkins, and N.R. Giffen. In press. Habitat disturbance at explosives-contaminated ranges. In Sunahara, G., J. Hawari, G. Lotufo, and R. Kuperman (eds.) *Ecotoxicology of Explosives and Unexploded Ordnance*, CRC Press, Boca Raton, FL.
- Efroymsen, R.A., V.H. Dale, L.M. Baskaran, M. Chang, M. Aldridge, and M. Berry. 2005. Planning transboundary ecological risk assessments at military installations. *Human and Ecological Risk Assessment* 11:1193-1215.

In review:

- Dale, V.H., F. Akhtar, M. Aldridge, L. Baskaran, M. Berry, M. Browne, M. Chang, R. Efroymsen, C. Garten, E. Lingerfelt, C. Stewart. Modeling impacts of land-use on quality of air, water, noise, and habitats for a five-county region in Georgia. *Ecology and Society*.